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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/608,347

06/27/2003

Chin-Tien Yang

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06/29/2004

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EXAMINER

PERKINS, PAMELA E

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 06/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

4

<b>Office Action Summary</b>	Application No. 10/608,347	Applicant(s) YANG ET AL.	
	Examiner Pamela E Perkins	Art Unit 2822	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 27 June 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 11-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)                                    | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

This office action is in response to the filing of the application papers on 27 June 2003. Claims 1-20 are pending.

#### ***Election/Restrictions***

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-10, drawn to a method of making a semiconductor device, classified in class 438, subclass 629.
- II. Claims 11-20, drawn to a semiconductor device, classified in class 257, subclass 751.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by another and materially different process. For example the polish layer of tungsten can be formed using a mask layer.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

During a telephone conversation with James Kesterson on 22 March 2004 a provisional election was made without traverse to prosecute the invention of group I, claims 1-10. Affirmation of this election must be made by applicant in replying to this Office action. Claims 11-20 withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 5 and 6 are rejected under 35 U.S.C. 102(b) as being anticipated by Park (5,930,670).

Park discloses a method of fabricating a tungsten plug where a substrate (21) has a lower portion and a layer of selected material (24) over the lower portion, the selected material (24) having a top surface; defining a trench (20) in the selected material (24) extending from the top surface toward the lower portion; depositing a layer

of tungsten (26) over the top surface of the layer of selected material (24), the tungsten (26) also filling the trench (20); polishing the tungsten layer (26) to remove a top portion of the tungsten layer (26); stopping the polishing so as to leave a reduced thickness of the tungsten layer (26) (Fig. 3B); and providing a contact area (27) over at least a portion of the tungsten (26) filled trench (20), wherein the contact area (27) in electrical contact with the tungsten (26) filling the trench (20). Park further discloses the substrate including a conductive area (23) covered by the layer of selected material (24) and wherein the trench (20) is a via extending through the layer of selected material (24) and the tungsten (26) in the via is in electrical contact with the conductive area (23) (col. 4, lines 22-60). Park also discloses the layer of selected material (24) is one of a layer of a dielectric material and a layer of insulating material (col. 4, lines 22-39). Park discloses depositing a liner material (16) in the trench (15) and over the top surface of the selected material (14) before depositing the layer of tungsten (18) (col. 3, lines 22-62).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4 and 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Kobayashi (6,610,597).

Park discloses the subject matter claimed above except the contact area and the conductive are made of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum.

Kobayashi discloses a method of fabricating a tungsten plug where a substrate (007) has a lower portion and a layer of selected material (008) over the lower portion, the selected material (008) having a top surface; defining a trench (021) in the selected material (008) extending from the top surface toward the lower portion; depositing a liner material (003) in the trench and over the top surface of the selected material (008); depositing a layer of tungsten (005) over the top surface of the layer of selected material (008), the tungsten also filling the trench (021); polishing the tungsten layer (005) to remove a top portion of the tungsten layer (005); and providing a contact area (010) over at least a portion of the tungsten (005) filled trench (021), wherein the contact area (010) is in electrical contact with the tungsten (005) filling trench (021). Kobayashi further discloses the substrate (007) including a conductive area (009) covered by the layer of selected material (008) and wherein the trench (021) is a via extending through the layer of selected material (008) and the tungsten (005) in the via is in electrical contact with the conductive area (009) (col. 10, line 19 thru col. 11, line 67). Kobayashi also discloses the layer of selected material (008) is one of a layer of a dielectric material and a layer of insulating material (col. 10, lines 19-34). Kobayashi discloses making the contact area (010) and the conductive area (009) of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum (col. 1, lines 29-41; col. 10, lines 19-26).

Since Park and Kobayashi are both from the same field of endeavor, a method of fabricating a tungsten plug, the purpose disclosed by Kobayashi would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Park by the contact area and the conductive are made of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum as taught by Kobayashi to prevent plug loss (col. 12, lines 1-7).

Referring to claim 4, Park discloses reduced layer of tungsten remaining after polishing is between 500 and 1000 Å (col. 4, lines 40-50). It is noted that the specification contains no disclosure of either the critical nature of the claimed concentrations or any unexpected results arising there from. It would have been obvious to one of ordinary skill in the art to form reduced layer of tungsten remaining after polishing is between 0.3 µm and 0.01 µm since it has been held that "In such an situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) See MPEP § 2144.05.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Bhowmik et al. (2003/0091870).

Park discloses the subject matter claimed above except the liner material is selected from the group consisting of tantalum, tantalum nitride, titanium, and titanium nitride.

Bhowmik et al. disclose a method of fabricating a tungsten plug where a substrate has a lower portion and a layer of selected material (20) over the lower portion, the selected material (20) having a top surface; defining a trench (25) in the selected material (20) extending from the top surface toward the lower portion; depositing a liner material (30) in the trench (25) and over the top surface of the selected material (20); depositing a layer of tungsten (60) over the top surface of the layer of selected material (20), the tungsten (60) filling the trench (25); and polishing the tungsten layer to remove a top portion of the tungsten layer (60) (para. 12-14). Bhowmik et al. further disclose the liner material (30) is selected from the group consisting of tantalum, tantalum nitride, titanium, and titanium nitride (para. 4).

Since Park and Bhowmik et al. are both from the same field of endeavor, a method of fabricating a tungsten plug, the purpose disclosed by Bhowmik et al. would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Park by the liner material is selected from the group consisting of tantalum, tantalum nitride, titanium, and titanium nitride as taught by Bhowmik et al. to improve reliability of the tungsten plug (para. 4).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (571)



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272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PEP

  
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